

Application of Nutrigenomics in Skin Health

Nutraceutical or Cosmeceutical?

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Abstract

Nutrigenomics is a growing field related to genetic testing based on the documentation of genetic mutations in an individual, giving us the ability to correct metabolic imbalances (personalized medicine) through specific dietary supplements or nutraceuticals. An off-shoot of nutrigenomics called dermagenetics (testing for selected genetic mutations related to skin health followed by advocating the use of either nutraceuticals or skin creams enriched by cosmeceuticals) is heading toward commercialization at a rapid rate by directly targeting the public. Although this growth represents an opportunity to explore the benefits of genetic advances in skin health, it is essential that the science, product claims, and ethical standards be critically evaluated and clear national guidelines be set in order to protect the consumer.

Nutrigenomic concepts

The field of nutrigenomics

promises the ability to tailor diet based on individual genetic make up.¹ Human Genome Project² has provided a framework for the following: a) documentation of single nucleotide polymorphisms (SNPs) in candidate genes; b) exploration of their association with metabolic imbalances; and c) creation of a panel of nutrigenomic tests that can be evaluated in the clinical laboratory. Studies based on ethnopharmacology, phytotherapy, and dietary supplement use have provided strong evidence for the interaction of nutrients and botanicals with the genome causing marked changes in gene expression^{3,4} and the ability of genetic variations to cause marked differences in individual response to dietary factors.⁵ This has led to the commercial development of nutraceuticals and functional foods that seek to modify negative health effects of individual genetic profile.^{6,7} Large-scale nutrition intervention studies currently underway will

further help validate nutrigenomic concepts in selected genes and continue to add new tests to the nutrigenomic panel.⁸ These nutrigenomic concepts are gaining popularity by giving the individuals at risk of developing metabolic problems some options to practice preventive health.

Dermagenetics and metabolomics

When evaluating the application of nutrigenomics to skin health, one has to be aware that the situation will present some unique options and concerns.^{9,10} While it is perfectly reasonable to assume that the skin tissue will derive some benefits of the nutraceuticals given orally, skin is also unique in being amenable to assimilating phytonutrients (so called cosmeceuticals) after direct topical application. Research studies examining the benefits of oral nutraceuticals have clearly shown that the oral route can indeed improve certain aspects of skin health.^{11,12} Recently, however, this approach has taken a twist by linking skin health with dermagenetics. Dermagenetics (an off shoot of nutrigenetics) examines selected genetic mutations to determine what nutraceuticals will offer to benefit the individual skin health. The common mutations examined are related to the enzymes involved in the following: a) collagen breakdown, b) photoaging and free oxygen radical elimination, c) degradation of environmental pollutants, and d) generation of pro-inflammatory molecules. Some companies have utilized dermagenetics to lure customers into getting expensive genetic testing, then recommend specific nutraceuticals or skin creams enriched by selected

cosmeceuticals. There are strong disagreements as to the validity of dermagenetics and its benefits for the following reasons: First, there is no guarantee that a given mutation will indeed display significant abnormalities at the blood and tissue levels due to the contributions of post-translational modifications. Second, no evaluation of blood parameters are actually made in subjects before recommending a selected nutraceutical. For example, the normal levels of blood oxidative stress parameters in a given individual are still not firmly established to warrant antioxidant or other dietary supplementation. It is suggested that dermagenetics could considerably benefit patients by incorporating metabolomics,¹³ a rapidly growing science that actually examines metabolite profiles in blood and tissues under defined conditions, providing meaningful basis for intervention.

The use of topical skin creams containing cosmeceuticals has developed into a multibillion dollar industry. How much benefit these cosmeceuticals actually provide when applied topically is currently a matter of debate.¹⁴ As discussed by Choi and Berson,¹⁵ the degree of benefits achieved might depend on formulation methods, the degree to which the active compounds can maintain integrity and the duration of their effects, and factors affecting their release from the carrier vehicles. How are these benefits evaluated? In most cases, the benefits of skin creams are evaluated not by their ability to change a given cell function, but rather by the appearance of the skin.¹⁵ The proliferation of skin care lotions claiming the ability to remove wrinkles and change skin

coloration and texture warrants that well-controlled efficacy studies be a prerequisite to actually claimed benefits of specific cosmeceuticals.^{16,17} Recent advancements in the application of nanotechnology^{18,19} to the development of cosmeceuticals will certainly enhance the penetration of the active ingredients into the skin and may offer maximum benefits.

Finally, as the field(s) related to nutritional genomics expand their scope into cosmetic and beauty products, it is essential that state/federal regulatory agencies set clear guidelines for diagnostic laboratories, especially for those offering genetic tests (that link with skin health) directly to consumers (without physician referrals); more strictly monitor health claims of ingredients in skin creams; and work with the universities to train physicians, nutritionists, and dietary professionals in nutrigenomics to meet the health challenges of this postgenomic era.

References

1. Subbiah MTR. Understanding the nutrigenomic definitions and concepts at the food-genome junction. *Omics J Integr Biol.* 2008;12:1-7.
2. Venter JC, Adams MD, Myers EW, et al. *Science.* 2001;291:1304-1351.
3. Fenech M. Genome health, nutrigenomics and nutrigenetics: diagnosis and nutritional treatment of genome damage on an individual basis. *Food Chem Toxicol.* 2008;46:1365-1370.
4. Shay NF, Banz WJ. Regulation of gene transcription by botanicals: novel regulatory mechanisms. *Ann Rev Nutr.* 2005;25:297-315.
5. Stover PJ. Influence of human genetic variation on nutritional requirements. *Amer J Clin Nutr.* 2006;83(Suppl):436S-442S.
6. Mizoguchi T, Takehara I, Masuzawa T, Saito T, Naoki Y. Nutrigenomic studies of effects of chlorella on subjects with high risk factors at the food-genome junction. *J Med Food.* 2008;11:395-404.
7. Bakker GC, van Erk MJ, Pellis L, et al. An anti-inflammatory dietary mix modulates inflammation and oxidative and metabolic stress in overweight men; a nutrigenomic approach. *Amer J Clin Nutr.* 2010;91:1044-1059.
8. Kaput J. Developing the promise of nutrigenomics through complete science and international collaborations. *Forum Nutr.* 2007;60:209-223.
9. Rattan SI. The science of healthy aging: genes, milieu and chance. *Ann NY Acad Sci.* 2007;1114:1-10.
10. Bergstrom KG. Beyond tretinoin: cosmeceuticals for aging skin. *J Drugs Dermatol.* 2009;8:674-677.
11. Udompataikul M, Sripiroj P, Palungwachira P. An oral nutraceutical containing antioxidants, minerals and glycosaminoglycans improves skin roughness and fine wrinkles. *Int J Cosmet Sci.* 2009;31:427-435.
12. Izumi T, Saito M, Obata A, et al. Oral intake of soy isoflavone aglycone improves the aged skin in adult women. *J Nutr Sci Vitaminol (Tokyo).* 2007;53:57-62.
13. Goodacre R. Metabolomics of a superorganism. *J Nutr.* 2007;137:259S-266S.
14. Choi CM, Berson DS. Cosmeceuticals. *Semin Cutan Med Surg.* 2006;25:163-168.
15. Draelos ZD. Cosmeceuticals: undefined, unclassified and unregulated. *Clin Dermatol.* 2009;27:431-434.
16. Gao XH, Zhang L, Wei H, Chen HD. Efficacy and safety of innovative

- cosmeceuticals. *Clin Dermatol*. 2008;26:367–374.
17. Bruce S. Cosmeceuticals for the attenuation of extrinsic and intrinsic dermal aging. *J Drugs Dermatol*. 2008;7(Suppl 2):S17–S22.
18. Guglielmini G. Nanostructured novel carrier for topical application. *Clin Dermatol*. 2008;26:341–346.
19. Booneme P, Junyaprasert VB, Suksawad N, Songkro S. Micro-emulsions and nanoemulsions: novel vehicles for whitening cosmeceuticals. *J Biomed Nanotechnol*. 2009;5:373–383.
20. Castle D, Ries NM. Ethical, legal and social issues in nutrigenomics: the challenge of regulating service delivery and building health professional capacity. *Mutat Res*. 2007; 622:138–143. ●

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COMMENTARY